

Fungi Can Whack Invasive Weeds

American farmers and homeowners spend millions combating weeds and other alien organisms introduced from foreign countries. With the increase in international commerce and trade, the number of alien species becoming established in this country is growing every year.

“Luckily, fungi provide a vast arsenal of ammunition to control noxious weeds—both established and newly arrived—that invade roadsides, rangelands, and waterways and crowd out useful and native plants,” says mycologist Amy Y. Rossman. She heads the Agricultural Research Service’s Systematic Botany and Mycology Laboratory in Beltsville, Maryland.

Fungi are among the most biologically diverse organisms on Earth. Once discovered and characterized, many previously unknown species can be put to work. Thanks to research at Rossman’s lab, ARS scientists at several U.S. laboratories are testing the effectiveness of three new fungus species as biocontrols for some of the United States’ major invasive weeds: ragweed, purple

loosestrife, kudzu, and morningglory.

Mycologist David F. Farr is curator of ARS’ U.S. National Fungus Collections, maintained at Beltsville. A systematist, Farr probes the collection’s 1 million fungal specimens to discover, name, scientifically describe, and classify agriculturally important fungi.

“Once these organisms are characterized, their weed-control potential can be tested in field and lab experiments,” says Farr. He recently discovered several fungi—two new to science—that may offer nonchemical control of these four weeds.

An Irritant Wherever It Grows

“Ragweed, *Ambrosia artemisiifolia*, is a noxious plant that infests thousands of acres of arable land worldwide and causes allergic reactions—often seasonal—in many people,” says Farr. “Its pollen causes irritated eyes, runny noses, and general discomfort for many sufferers.

“Last year, scientists in Hungary—where ragweed is even more of a problem—reported that they had found a fungus, possibly a *Septoria*, that was pathogenic to ragweed. It causes leaves to die and kills some plants, probably by entering through leaf pores.”

After searching the literature and fungus collection, Farr determined that this beneficial species of *Septoria* is also found in the United States, though not previously described anywhere. Using molecular sequencing, he characterized it, named it *S. epambrosiae*, and illustrated it. Then he showed it to be distinct from three other related, known *Septoria* species.

“Scientists will use this information to communicate about the new fungus in developing it as a biocontrol agent for ragweed,” says Farr.

Garden Plant Gone Wild

One of the other fungi that Farr discovered was one that attacks purple loosestrife, *Lythrum salicaria*.

“This perennial garden plant has become a noxious weed and is spreading

rapidly throughout North America,” says Farr. “Native to Europe and Asia, purple loosestrife grows and reproduces prolifically in wetlands and other moist habitats. It’s degrading the quality of thousands of acres of wetlands, becoming the dominant vegetation by out-competing native plants that provide critical food, shelter, and breeding areas for wildlife.”

After careful examination of form and structure and DNA sequencing, Farr was able to determine the molecular fingerprint of the fungus—also new to science.

“We described, illustrated, and named it *Harknessia lythrii*,” says Farr. “Many species of *Harknessia* are host specific—but not all of them—so scientists need to ensure that this fungus attacks only purple loosestrife.”

Kudzu—A Colossal Creep

Plant pathologist C. Douglas Boyette at ARS’ Southern Weed Science Research Unit, Stoneville, Mississippi, recently discovered that the sicklepod fungus *Myrothecium verrucaria* is also

PEGGY GREB (K9674-1)



In a field of kudzu, technician Jimmy McAlpi5ne (left) takes a sample to check the effectiveness of a bioherbicide. Plant pathologist Douglas Boyette looks on.

PEGGY GREB (K9675-1)



Flowering kudzu is a fast-growing legume with a grapelike odor.

an effective bioherbicide for controlling kudzu. This fast-growing, nonnative weed covers more than 7 million acres of the South.

"Kudzu resembles a giant beanstalk," says Boyette. "It spreads at a rate of about 120,000 acres a year, reducing land productivity. Homeowners have a hard time controlling this vine, which grows up the sides of buildings, along fences, and on trees and telephone poles. Control costs increase by nearly \$6 million each year."

In greenhouse and small field plot studies, Boyette and ARS plant pathologist Hamed K. Abbas found that the *Myrothecium* bioherbicide killed 100 percent of kudzu weeds treated at different growth stages and under varying physical and environmental conditions. It should provide a good nonchemical control alternative, since one spray treatment kills leaves and stems and appears to invade the roots. This research was done in collaboration with Louisiana Tech University-Ruston.

The Stoneville researchers are doing extensive toxicological studies on the

fungus and are looking for a company to license the patented kudzu-control technology.

Quarantine and Morningglories

Farr recently collaborated with ARS plant pathologist Douglas G. Luster, who is at the ARS Foreign Disease-Weed Science Research Unit in Frederick, Maryland, on the systematics of a different strain of *M. verrucaria*. With four microbial containment greenhouses, this unit is the nation's largest facility for studying whole plants under quarantine conditions.

Scientists there have developed techniques to monitor biocontrol agents after release into the environment. They use the polymerase chain reaction, amplified fragment length polymorphism, DNA sequencing, molecular marking, and other sensitive technologies to detect and identify a weed pathogen's unique genetic fingerprint. This lets them differentiate strains of the same fungal species.

"DNA fingerprinting also helps scientists keep close tabs on spore growth and spread, host range, and effectiveness of biocontrol pathogens like *Myrothecium* once they've been released," Luster says. They've fingerprinted several strains of this soil fungus that kill morningglories, a weed that plagues sugarcane growers.

Luster and ARS plant pathologist Dana K. Berner are testing the *M. verrucaria* fungus for broad-spectrum weed control. In field studies, spraying redroot- and smallflower-morningglories with an oil-based carrier containing *Myrothecium* spores proved as lethal to these weeds as the herbicide atrazine. Berner conducted the study with ARS agronomist Rex W. Millhollon at the Sugarcane Research Unit, Houma, Louisiana.

DNA fingerprinting offers genetic evidence linking a specific microbial release to a specific disease seen in target weeds. It can also reveal the spread of

biocontrol microbes and demonstrate their effectiveness in reducing invasive weed populations, the scientists say.—By **Hank Becker**, formerly with ARS.

This research is part of Crop Protection and Quarantine, an ARS National Program (#304) described on the World Wide Web at <http://www.nps.ars.usda.gov>.

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PEGGY GREB (K9671-1)



Mycologist Amy Rossman examines giant ragweed.

PEGGY GREB (K9673-1)



Leaves of giant ragweed may harbor fungi that could be used to control this noxious weed. Mycologist David Farr searches for signs of fungal infection.